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Black Stain Root Disease of Conifers

Richard S. Smith, Jr.¹ and David Graham²

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The black stain root disease of conifers, caused by the fungus *Verticicladiella wagnerii* Kend., is a relatively recently reported disease which is becoming more prevalent in the coniferous forests of Western United States. It is not currently causing significant losses in commercial forests, but it has become more widespread than earlier findings had suggested. This disease has caused heavy losses of noncommercial species in some high-value recreation lands.

Hosts and Distribution

The disease is limited to Western North America (fig. 1). To date, it has been reported on *Pinus edulis* Engelm. in Arizona,

Colorado, and Utah; on *Pinus monophylla* Torr. and Frem. in California and Nevada; on *Pinus attenuata* Lemm., *Pinus jeffreyi* Grev. and Balf., *Pinus lambertiana* Dougl., *Pinus monticola* Dougl., and *Pinus ponderosa* Laws. in California; on *Pseudotsuga menziesii* (Mirb.) Franco in California, Oregon, and Washington; and on *Pinus strobus* L. and *Pinus contorta* Dougl. in Montana. Studies have shown that some true firs, such as *Abies concolor* (Gord. and Glenn.) Lindl., and *A. magnifica* A. Murr., are resistant to this disease. Field evidence indicates that *Juniperus osteosperma* (Torr.) Little also is resistant.

Black stain root disease exists under a wide variety of environmental conditions. It is found in a region ranging from the hot, semiarid areas of the Southwest to Pacific coastal areas receiving over 60 inches of rain annually. It also occurs in a wide variety of

¹ Plant pathologist, Pacific Southwest Forest and Range Experiment Station, USDA Forest Service, Berkeley, Calif.

² Forest pathologist, Pacific Northwest Region, USDA Forest Service, Portland, Oreg.



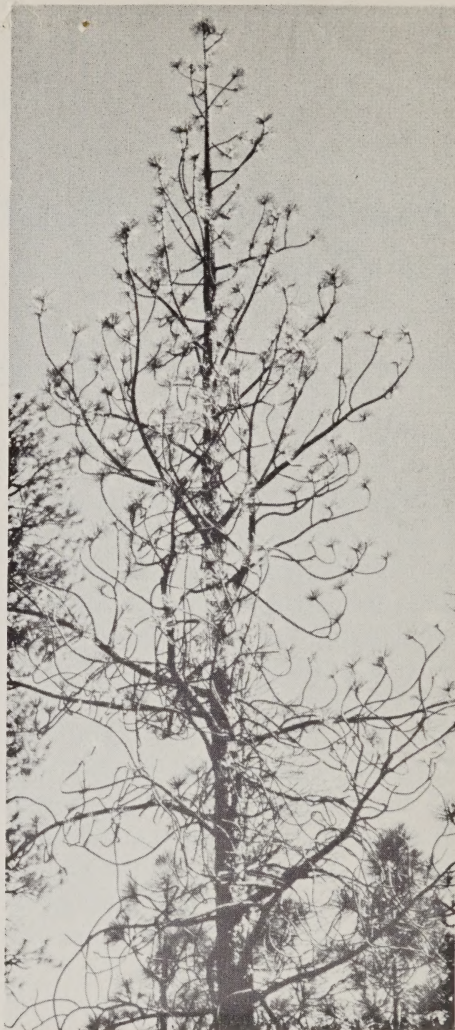
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Figure 1.—Distribution of the black stain root disease caused by *Verticillium dactylophorum* in the forests of Western United States. Each dot represents a general area in which one or more centers of this root disease have been found.

soils, ranging from shallow rocky soils to deep clay loams. It has an altitudinal range from sea level up to 9,000 feet.

Symptoms

Early symptoms of this disease are a reduction in terminal growth, chlorosis of the needles, reduced needle length, and reduced needle retention. The crown becomes thin and yellow (fig. 2), a condition also symptomatic of such other root diseases as Anisotoma root disease and Armillaria root rot. In 1 to 8 years after symptoms first appear, terminal growth stops, and the tree dies shortly thereafter.

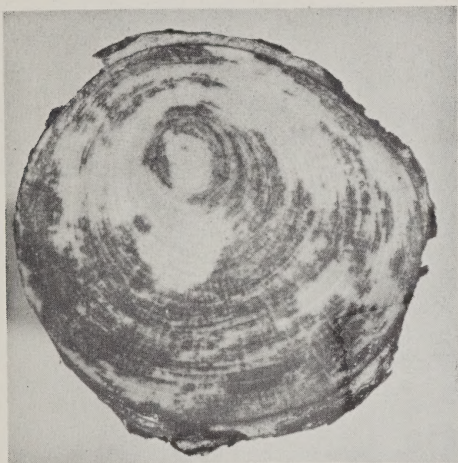


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Figure 2.—An infected Jeffrey pine shows the typical black stain root disease symptoms: a thin, chlorotic crown, short needles, poor needle retention, and reduced terminal growth.

The black stain root disease is most easily identified by a chocolate to black stain in the sapwood of the roots and root crown. This stain in a cross section of a stem

or root is not wedge shaped as in most blue stains, but, instead, tends to occur in arcs that parallel the annual rings (fig. 3). Most blue stain fungi concentrate in the medullary rays and advance along them, whereas *V. wagnerii* progresses through the tracheids and is not found in the ray parenchyma. The stained wood is usually heavily impregnated with resin.



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Figure 3.—A cross section of singleleaf pinyon pine root infected with *Verticicladiella wagnerii* shows how the black stain occurs in arcs that parallel the annual rings.

Bark beetles often invade an infected tree before it dies. This attack tends to obscure the basic cause of death.

Disease Cycle

The pathogen infects the sapwood of the roots, root crown, and lower bole of the coniferous hosts. There it causes a wilt type

of disease similar to oak wilt and Dutch elm disease. The pathogen is restricted to the tracheids of the xylem cylinder, and until the tree dies is not found in the cambial layer of the inner bark.

In established infection centers, the disease spreads from one host to another by means of root contacts or root grafts. As each new host is contacted it becomes infected and eventually dies. The circle of dead and dying trees enlarges as a result, with the recently infected and dying trees on the periphery of the infection center.

How the pathogen becomes established in new centers is not known. An insect vector may be involved.

Damage

The disease has caused considerable damage in certain parts of Southwestern United States. In Mesa Verde National Park, some 12,000 dead and dying trees infected with *V. wagnerii* were removed in 1933 and 1934. In southern California, the disease is epidemic on some 8,000 acres of single leaf pinyon pine. In the White Mountains, it has caused extensive killing of pinyon pine within one-half mile of the Ancient Bristlecone Pine Reserve. By predisposing a tree to bark beetle attack the disease also contributes to the buildup of insect populations.

Control

No means of control for the black stain root disease are known. The growing of resistant species, such as true firs or western juniper, in infection centers of the disease is suggested as a means of limited control.

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